Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Facilitating Research and Regulation of Biological Control: The role of petition reviews

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Canada

Balancing Benefits & Risks

Petitions for release of biocontrol agents aid this decision

A Brief History

- **1957 – Subcommittee on Biological Control of Weeds established in the U.S.**
- **1962 – An informal, reciprocal review of proposals began between the U.S. and Canada**
- **1969 – Membership of Subcommittee expanded to include specialists in plant taxonomy, ornamentals, and plant quarantine**
- **1971 – Subcommittee's name changed to Working Group; contacts were established with Mexican officials concerning U.S. proposals**

A Brief History

- **1990's** – Canada set up a more formal process similar to the U.S. Working Group
- **1998** – Canada had a well-defined system that included screening natural enemies of arthropods
- **2000** – Plant Protection Act - APHIS-PPQ initiated an informal agreement with Canadian counterparts for screening entomophagous agents based on the NAPPO standard [Prior to this time, with no authority over entomophagous agents, APHIS-PPQ would sometimes issue a "courtesy permit"]

North American Plant Protection Organization

- **NAPPO is a regional plant protection organization under the auspices of the Food and Agriculture Organization (FAO)**
- **NAPPO mandate is to develop regional phytosanitary standards**

http://www.nappo.org

NAPPO Standards

RSPM N° 12

Guidelines for Petition for First Release of Exotic Entomophagous Biological Control Agents

General Requirements

1. Proposed Action
2. Target Pest Information
3. Biological Control Agent Information
4. Environmental and Economic Impacts of Proposed Release
5. Post Release Monitoring

RSPM No. 7

Guidelines for Petition for First Release of Exotic Phytophagous Biological Control Agents

General Requirements

1. Proposed Action
2. Target Weed Information
3. Biological Control Agent Information
4. Host-Specificity Testing
5. Environmental and Economic Impacts of Proposed Release
6. Post-Release Monitoring

Title page - ‘**Petition for the Release of XXX for the Biological Control of YYY**’
Name(s) and address of Petitioner(s)
Summary or Abstract

1. Proposed Action

1.1 Purpose of the release.
1.2 Need for the release.
1.3 Reasons for choice of the entomophagous biological control agent.
1.4 Specific location of rearing/containment facility and name(s) of qualified personnel operating the facility.
1.5 Timing of the release (approximate date of release) and factors affecting the timing (e.g. life stage of target pest, season)
1.6 Location of initial release (including geographic coordinates).
1.7 Methods to be used (e.g., rearing, multiplication, release).
1.8 Methods to be used for disposing of any host material, pathogens, parasites, parasitoids, and hyperparasitoids accompanying an import.
1.9 Agencies and/or individuals that will be involved in the release and monitoring.

2. Target Pest Information

2.1 Taxonomy: scientific name, full classification, synonymy, common names (if any), and sufficient characterization to allow unambiguous recognition.

2.2 Economic impact and benefits (if any) of the target pest.

2.3 Life history of the target pest.

2.4 Distribution of the target pest.

2.5 Economically and ecologically important species in North America (introduced and native) related (phylogenetically and/or ecologically) to the target pest.

2.6 Regulatory and/or pest status of the target pest in state, provincial or federal law.

2.7 Knowledge of status of other biological control agents (indigenous and introduced) that attack the target pest.

2.8 Life stage(s) of target pest that are vulnerable to the biological control agent.

3. Biological Control Agent Information

3.1 Taxonomy: scientific name, synonymy, common names and name of the taxonomic authority making the identification of the biological control agent.

3.2 Methods used to identify the biological control agent (e.g., morphological, molecular).

3.3 Location of voucher specimens.

3.4 Natural geographic range, other areas where introduced, and expected attainable range in North America (also habitat preference and climatic requirements of the biological control agent).

3.5 Source of the biological control agent (laboratory/rearing facility/containment facility, original collection locality, name of collector, and name of identifier).

3.6 Host/Biological control agent interactions (e.g., parasitoid, pathogen, parasite, competitor, and antagonist)

3.7 Life history (including dispersal capability and damage inflicted on target pest).

3.8 Known host range based on valid literature records, host data from museum specimens, and unpublished records.

3.9 History of past use of the biological control agent.

3.10 Pathogens, parasites, parasitoids, and hyperparasitoids of the biological control agent and how to eliminate them from a culture of the biological control agent.

3.11 Standard Operating Procedure stating how the biological control agent will be handled in containment.

3.12 Other closely related genera, sibling species, or similar species of the biological control agent in North America.

4. Host-Specificity Testing

4.1 Selection of test plants: subspecies, species, subgenera, genera and other closely-related plants and plants recorded as hosts in the literature, museum labels or other unpublished collection records, agriculture pest reports, etc.; hosts of close relatives (i.e. in the same genus) of the candidate agent; unrelated plants having physical and chemical similarities to the weed, habitat associates, rare and endangered species, and economic plants.

4.2 Laboratory tests (multiple and no-choice feeding tests, oviposition tests, development tests).

4.3 Field tests (in country of origin).

[required for weed agents only]

4. Environmental & Economic Impacts of the Proposed Release

4.1 Known impact on vertebrates including humans.

4.2 Implications of not releasing this biological control agent (e.g., pesticide use, physical controls).

4.3 Direct impact of the biological control agent on target pest and non-target species.

4.4 Effects on physical environment (e.g., water, soil and air resources).

4.5 Indirect effects (e.g., potential impacts on organisms that depend on the target pest and non-target species, including potential competition with resident biological control agents).

4.6 Possible direct, or indirect effects on threatened and endangered species in North America.

5. Post-Release Monitoring Researchers and practitioners should publish details on the economic and environmental impacts of programs, as soon as practical, after release of the biological control agent. Comparing predicted and observed behavior and performance of biological control agents is necessary to validate and improve regulatory systems. Further, monitoring can provide useful information for current programs. For example, additional releases may be suspended if proven ineffective, when control/balance is achieved, or if unintended impacts are observed. Therefore, to assist in assessing program impacts, information is requested on plans for post-release monitoring.

In designing monitoring plans please note that pre-release baseline measurements of target pests and non-target species provide for better monitoring data and documentation of effects. Also, some effects may take years or decades to manifest while others may not be long lasting.

The key elements to monitor are:

5.1 Biological control agent establishment and spread.

5.2 Biological control agent and target pest densities over time.

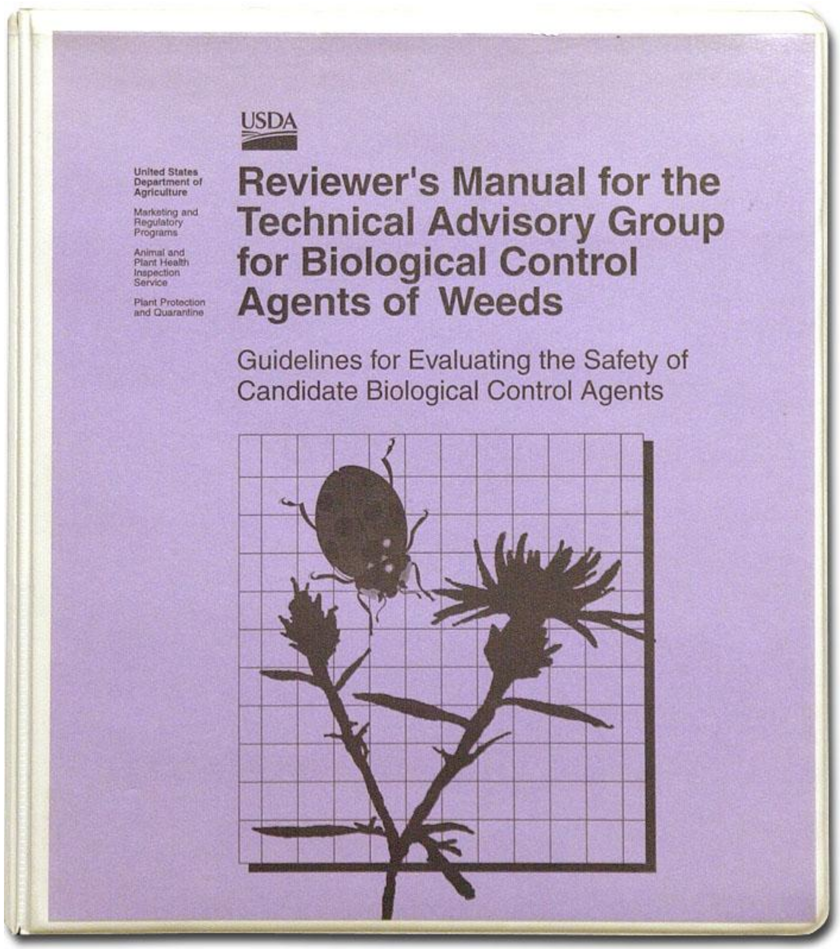
5.3 Host specificity/attack rates on the target pest and selected non-target species for which potential impacts are identified (e.g., threatened or endangered species, and taxonomically related or beneficial species). Methods should measure both biological control agent host preference and development.

5.4 Changes in the target pest and in the growth, survival, and reproduction of selected non-target species.

5.5 Changes in species diversity and community structure. Monitor the displacement or exclusion of native natural enemies, local extinctions, replacement of the target pest as the main host, and other direct and indirect effects.

NOTE: **Voucher specimens must be deposited in a National Collection in advance of approval for release. The specimens must be clearly labeled, indicating collection locality, latitude and longitude, date of collection, name of collector and any other pertinent information. Researchers must also provide exact location and timing of release(s) to regulatory officials.**

Technical Advisory Group



- TAG is a USDA-APHIS committee whose mandate is exclusive to the U.S.
- More detail than NAPPO standard in some requirements, e.g. Test Plant List

Test Plant List – (Wapshere 1974)

Category 1: Genetic types of the target weed species (varieties, races, forms, genotypes, apomicts, etc.)

Category 2: Species in the same genus as the target weed

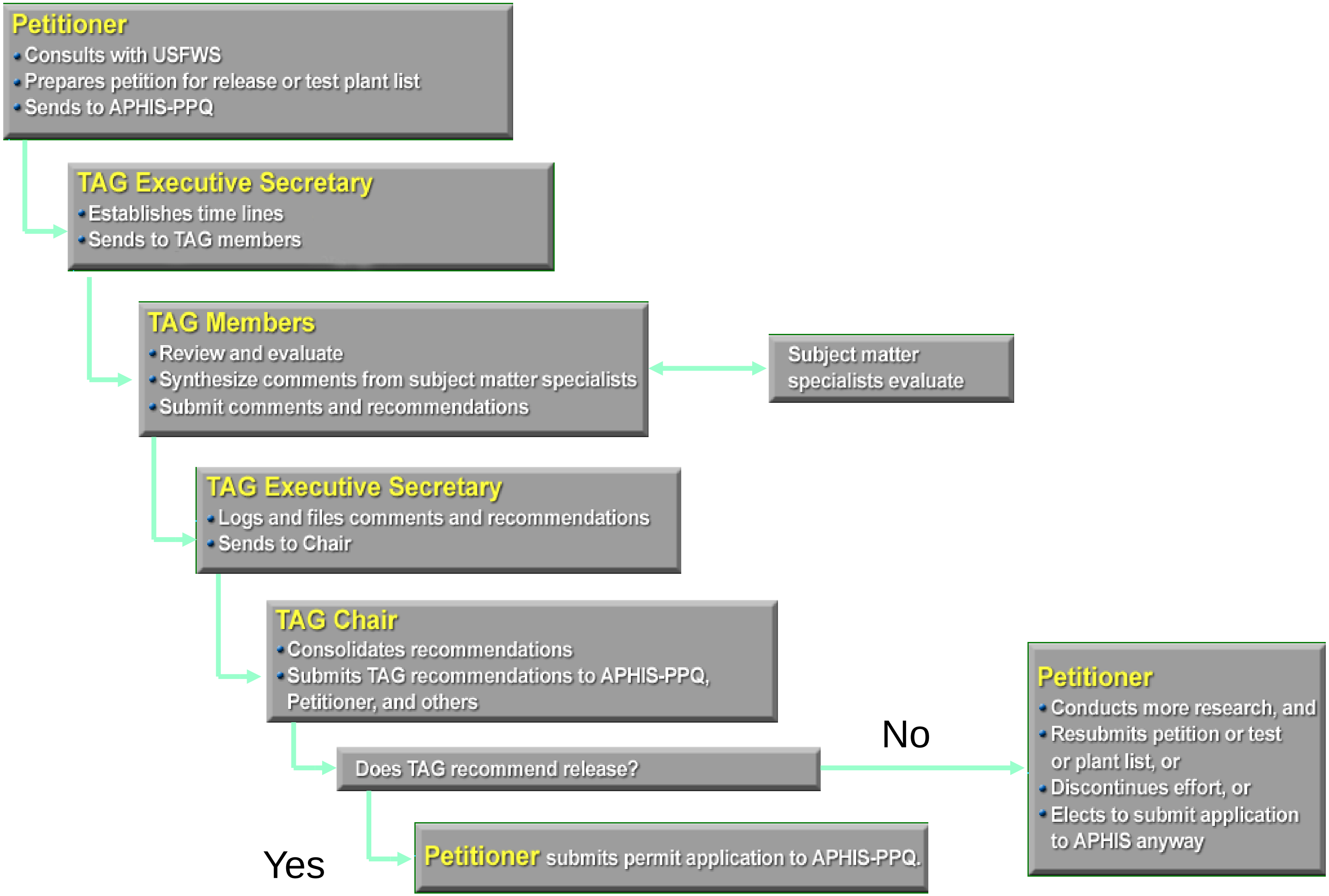
Category 3: Species in other genera in the same family as the target weed

Category 4: Threatened and endangered spp. in same family as target weed

Category 5: Species in other families in same order that have some phylogenetic, morphological, or biochemical similarities to the target weeds, or that share the same habitat, including economically and environmentally important plants in North America

Category 6: Species in other orders that have some morphological, or biochemical similarities to the target weeds, or that share the same habitat, including economic and environmentally important plants in North America

Category 7: Any plant on which the BC agent or its close relatives (within the same genus) have been previously found or recorded to feed and/or reproduce


Petitioner
Consults with USFWS
Prepares petition for release or test plant list
Sends to APHIS-PPQ
TAG Executive Secretary
Establishes time lines
Sends to TAG members
TAG Members
Review and evaluate
Synthesize comments from subject matter specialists
Submit comments and recommendations
Subject matter specialists evaluate
TAG Executive Secretary
Logs and files comments and recommendations
Sends to Chair
TAG Chair
Consolidates recommendations
Submits TAG recommendations to APHIS-PPQ, Petitioner, and others
Does TAG recommend release?
No
Petitioner
Conducts more research, and
Resubmits petition or test or plant list, or
Discontinues effort, or
Elects to submit application to APHIS anyway
Yes
Petitioner submits permit application to APHIS-PPQ.

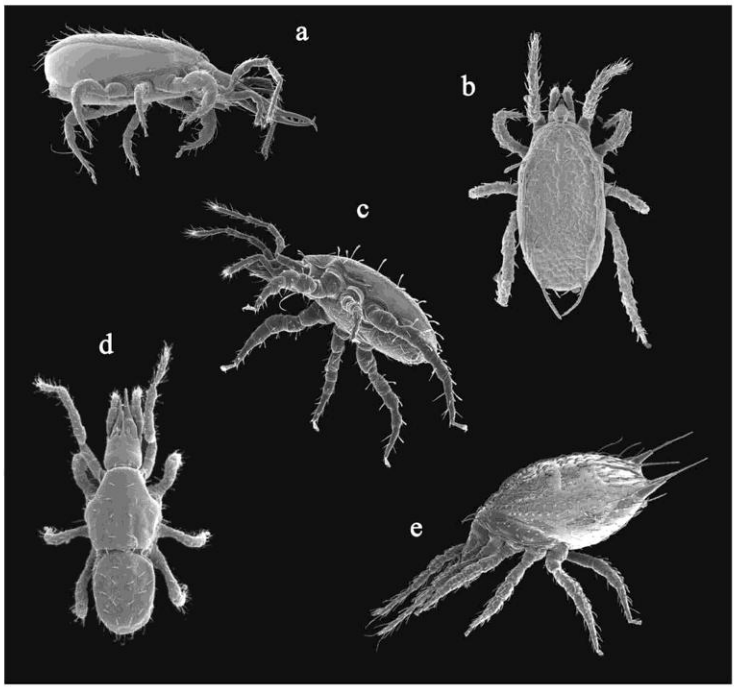
What do petitions achieve?

- Research
  - Researcher brings all the data together
  - Information gaps are identified
  - New methodology is developed
  - Biodiversity science is advanced
- Regulation
  - Test list provides a feedback mechanism
  - Full petition provides a science-based data package for benefit-risk decision
  - Peer-reviewed publication of data provides further scientific support to decision

Issues that petitions flag

- What if the agent is an undescribed species?
- What non-target species should be tested?
- Can host range be predicted objectively?
- What if populations of the agent from different source locations behave differently in testing?
- What if post-release monitoring shows non-target impact?
- What is impact?

What if the agent is an undescribed species?



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Article

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Review of the mite genus *Gaeolaelaps* Evans & Till (Acari: Laelapidae), and description of a new species from North America, *G. gillespiei* n. sp.

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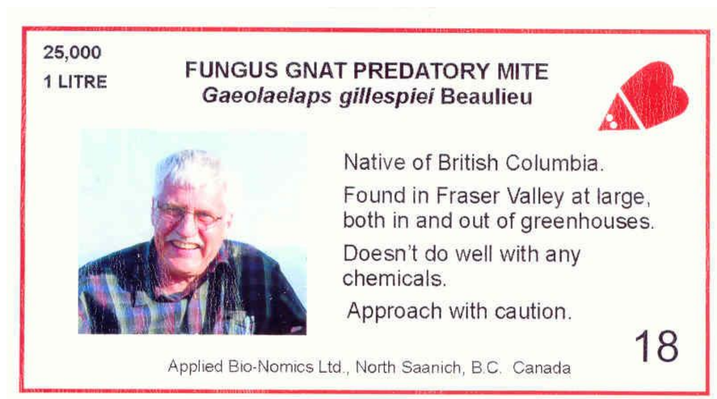
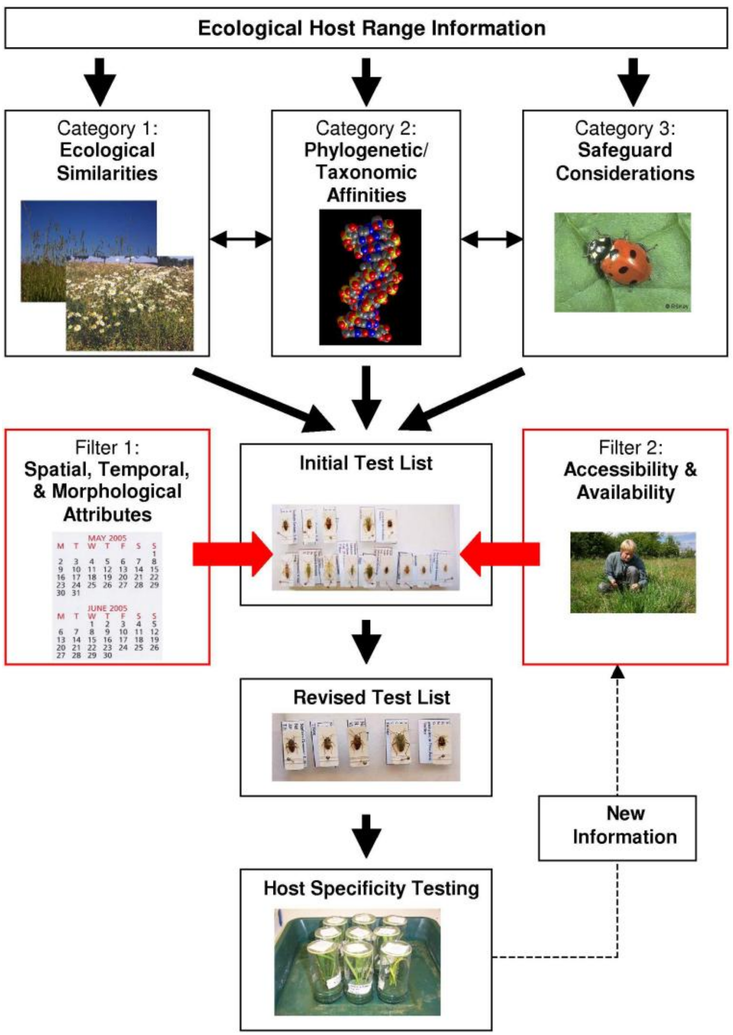
Abstract

The concept of the genus *Gaeolaelaps* of the mite family Laelapidae is reviewed, based on species descriptions in the literature and the examination of specimens of selected described and undescribed species. A short diagnosis and a description of the genus is presented, showing the range of morphological character states and indicating species that depart from the typical character states. *Gaeolaelaps* is restored from subgeneric to generic rank. A new species, *G. gillespiei* **n. sp.**, is described from adult female and male specimens. This species shows promise in the control of fungus gnats and thrips on greenhouse cucumbers in British Columbia, Canada. It is a relative of the well known biocontrol agent *Gaeolaelaps* (or *Hypoaspis*) *aculeifer*, but presents a set of morphological traits that distinguish it from *G. aculeifer* and other related species. The diversity of soil-dwelling mesostigmatic mites remains poorly explored, and so is their potential for biological control.

Key words: *Hypoaspis*, Hypoaspidinae, Mesostigmata, predatory mite, biocontrol



What non-target species should be tested?



2 Selection of Non-target Species for Host Specificity Testing

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Can host range be predicted objectively?

Contents lists available at ScienceDirect

Biological Control

journal homepage: www.elsevier.com/locate/ybcon

Mixed model analysis combining disease ratings and DNA sequences to determine host range of *Uromyces salsolae* for biological control of Russian thistle

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Table 2
Least squares mean estimators and mixed model predictors (BLUPs) of disease reaction to *Uromyces salsolae*. The table is arranged in descending order by BLUP value.

Genus species[a]	Least squares means estimators			Mixed model predictors		
	Least squares means estimates	Standard error of estimate	Lettered grouping	BLUP[b]	Standard error of prediction[c]	Pr > |t|[d]
Salsola kali-U.K.	132.10	10.89	AB	102.94	5.30	0.006
Salsola tragus	141.59	3.71	A	101.97	5.10	0.007
Salsola kali-Akhani	NT[e]	NT		97.02	4.85	0.023
Salsola paulsenii	120.34	44.09	ABC	96.90	4.65	0.023
Salsola collina	62.05	0.54	C	95.61	5.33	0.019
Salsola australis	60.20	3.38	C	95.47	4.94	0.028
Salsola kali-Maui	36.67	52.20	ABC	92.71	6.23	0.037
Halogeton glomeratus	129.24	6.01	AB	86.09	7.94	NS[f]
Halothamnus subaphyllus[g]	NT	NT		82.58	8.10	NS
Salsola soda	60.20	4.76	C	79.44	8.26	NS
Bassia hyssopifolia	52.64	39.61	ABC	67.32	9.44	NS
Krascheninnikovia ceratoides	61.75	0.66	C	64.31	8.86	NS
Sarcobatus vermiculatus	61.80	0.52	C	63.59	9.67	NS
Mirabilis multiflora	61.72	0.65	C	63.35	10.86	NS
Spinacia oleraceae	60.20	3.38	C	62.99	9.39	NS
Brassica oleracea	60.20	3.38	C	62.97	11.74	NS
Atriplex patula	60.20	3.38	C	62.00	6.80	NS
Suaeda taxifolia	60.20	3.38	C	61.64	7.80	NS
Suaeda moquinii	61.25	1.57	C	61.57	7.85	NS
Beta vulgaris	60.20	2.13	C	61.32	7.57	NS
Allium cepa	60.20	3.38	C	61.24	12.57	NS
Sorghum bicolor	60.20	3.38	C	60.91	11.86	NS
Lycopersicon esculentum	60.07	4.74	C	60.76	10.90	NS
Atriplex canescens	60.20	3.38	C	60.25	6.92	NS
Chenopodium album	60.20	3.38	C	60.19	8.80	NS
Chenopodium ambrosioides	60.20	3.38	C	60.13	10.17	NS
Suckleya suckleyana	61.29	2.01	C	59.91	9.65	NS
Glycine max	60.20	3.38	C	59.87	11.70	NS
Atriplex lentiformis	61.06	2.01	C	59.84	6.71	NS
Atriplex semibaccata	60.07	4.74	C	59.58	6.93	NS
Allenrolfea occidentalis	60.20	3.38	C	58.67	8.29	NS
Zuckia brandegeei	60.20	3.38	C	58.57	6.60	NS
Grayia spinosa	60.07	4.74	C	58.50	6.95	NS
Carthamus tinctorius	60.20	3.38	C	56.45	11.13	NS
Salicornia europaea	60.03	4.76	C	54.55	7.93	NS
Salicornia bigelovii	61.21	2.22	C	54.47	7.93	NS
Sarcocornia utahensis	28.65	37.24	C	51.92	8.12	NS
Corispermum americanum	61.80	0.52	C	—[h]	—	—

[a] Species are arranged in order of descending BLUP values.

Uromyces salsolae Rabehn, 1871

What if populations of the agent from different source locations behave differently in testing?

Figure 1. Worldwide distribution of the medfly. Each dot represents a country or island where populations have become established.

1010 Experientia 48 (1992), Birkhäuser Verlag, CH-4010 Basel/Switzerland **Research Articles**

Geographic populations of the medfly may be differentiated by mitochondrial DNA variation

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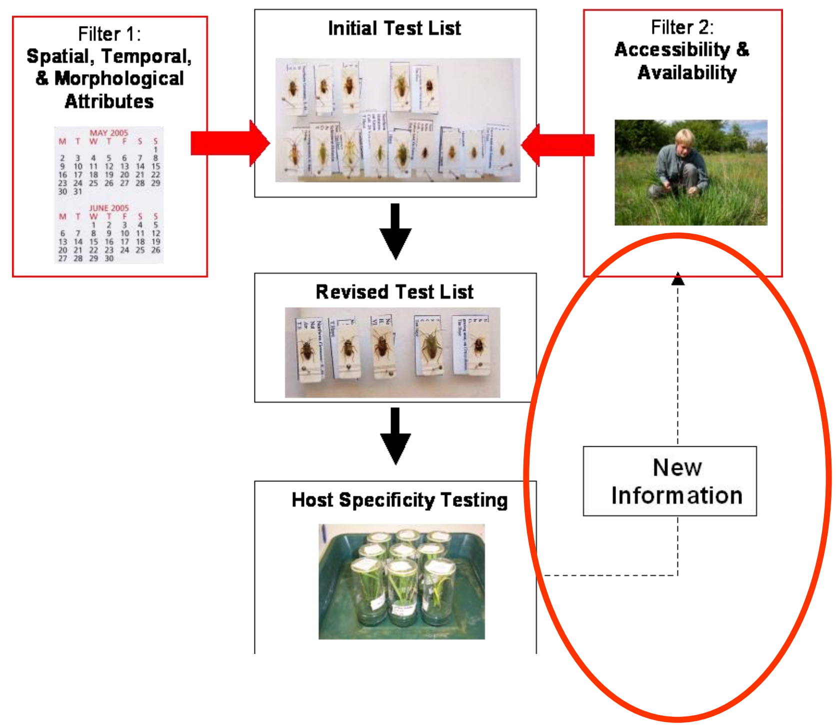
Abstract. Restriction enzyme cleavage sites of mitochondrial DNA (mtDNA) from the Mediterranean fruit fly were found to vary among introduced populations in the Neotropics. The survey included samples from 15 established natural populations and 5 laboratory cultures from Hawaii, Central America, South America and West Africa and samples from recent California infestations (1989, 1991). Based on restriction fragment length polymorphisms from 2 enzymes, Hawaii is an unlikely source for the 1989 and 1991 California infestations. Interpopulational variation in mtDNA demonstrates the potential for the technique to trace the process of colonization (geographic spread) by this insect.
Key words. Mediterranean fruit fly; *Ceratitis capitata*; mitochondrial DNA; colonization.

The Mediterranean fruit fly or medfly, *Ceratitis capitata* (Wiedemann), is recognized as one of the most serious pest of fruits and vegetables wherever it has become established in tropical and subtropical areas of the world. Although probably originating in equatorial Africa, it has expanded its geographical and host range over the course of the past 150 years, spreading to the Mediterranean (1842), southern Africa (1889), Australia (1887), South America (1901), Hawaii (1910), Central America

peared in the continental United States in Florida in 1929 and $ 7.5 million was spent to eradicate it[4]. USDA Animal and Plant Health Inspection Service recently allocated $ 9.7 million annually for medfly detection and exclusion activities[5]. Preventative costs are small, however, compared to the cost of an infestation. In recent years, California in particular has been periodically plagued with medfly infestations[6]. Estimated expenditures by the State of California for medfly eradication efforts in

What if populations of the agent from different source locations behave differently in testing?

Figure 1. Worldwide distribution of the medfly. Each dot represents a country or island where populations have become established.

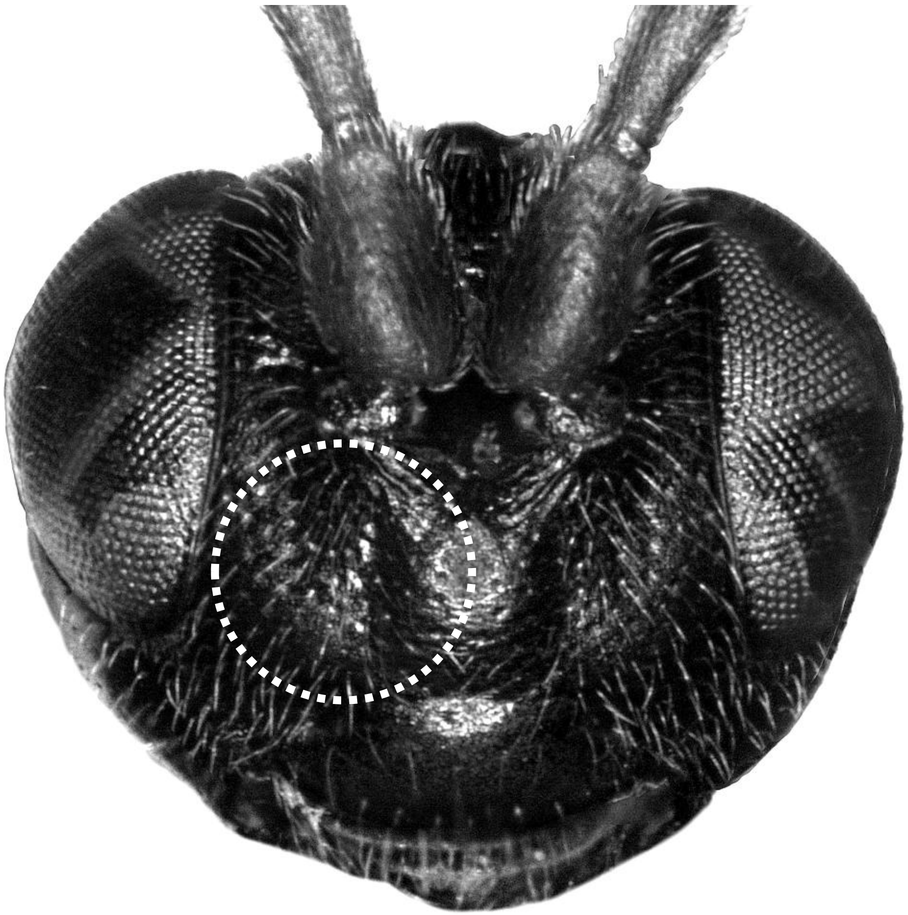


What if post-release monitoring appears to show non-target impact?

Species a

Species b

What if post-release monitoring appears to show non-target impact?



Species a

Species b

What is impact?

Petition reviews benefit both research on and regulation of biological control agents

- Communication is facilitated
- Research is advanced through
  - development of new methodologies
  - better understanding of the organisms and their environment
- Science-based dossier backs up the decision

Acknowledgements

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